

100 FILE COPY

Naval Air Systems Command Spares
Budgeting Model (SBM)

4 Aug. 1989

1

AD-A214 906

DTIC
S ELECTE DEC 0 4 1989 D
Dcs

CLEARED
FOR OPEN PUBLICATION
AUG 4 1989

CONGRESSIONAL AND
PUBLIC AFFAIRS OFFICE
NAVAL AIR SYSTEMS COMMAND

Mr. Paul R. Venzlowsky (AIR-4121)
Naval AIR Systems Command
Washington, D.C. 20361-4120
(202) 692-0126

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

UNCLASSIFIED

89 11 3 35

SECTION 1

INTRODUCTION

The Spares Budgeting Model (SBM) is a software package which computes readiness-based budgets for initial interim spares supporting new Naval aircraft and aircraft systems. The model was developed for the primary use of the Supply Policy and Management Division of the Naval Air Systems Command (AIR-412).

In this section:

- **Background** discusses the requirement for an AIR-412 budget model.
- **Definition of Key Terms in Spares Budgeting** defines "spares", "WRAs, SRAs, & piece parts", "initial budget", "MSD", "interim support", and "initial interim spares budget."
- **Model Description** addresses the elements of the system that comprise the SBM.
- **SBM Advantages** lists the benefits of using the SBM in preparing spares budgets.
- **Security** discusses the security aspects of working with the model.

Accession For	
NTIS	CRA&I
DTIC	TAB
Unannounced	
Justification	
By _____	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	



Background

Budget Requirement AIR-412 is responsible for preparing, and defending through all levels of review, the budget requirements for initial interim spares for new Naval aircraft and aircraft systems. Budget estimates for the Program Objective Memorandum (POM) and System Acquisition Request (SAR) submissions are included in this responsibility.

Budget Preparation The preparation of weapon system budgets in the Department of Defense (DoD) is typically a tedious and formidable task. Faced with the uncertainty of the future, government budgeters must often work with little information to prepare budgets that span several years. (SDW)

Once a budget is prepared, it must undergo several levels of review. During these reviews, budgeters must defend their efforts and must be able to quickly make revisions.

AIR-412 Budget Preparation

The preparation of initial interim spares budgets for new Naval aircraft and aircraft systems is no exception. Logistics Element Managers (LEMs) in AIR-412 must often construct budgets for 5 or more years with little or no information on aircraft configuration.

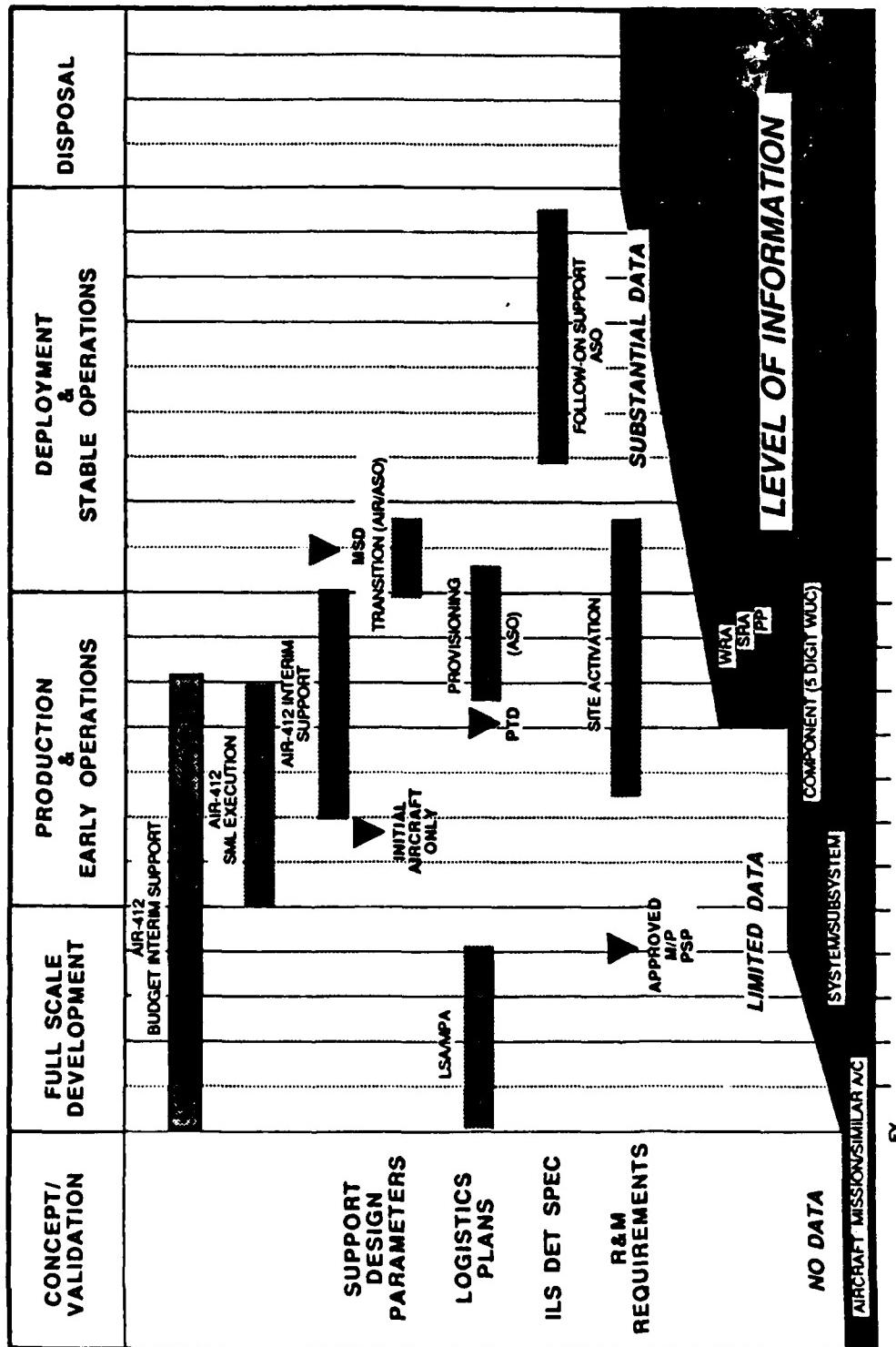
Figure 1 portrays the spares budgeting information challenge. As shown, LEMs must prepare budgets years before detailed component information is known. Not only is their job hampered by a lack of uniformity in the availability of information but also by a lack of uniformity in its quantity and quality.

Need for a Model

These information problems have forced unstructured approaches to interim spares budgeting. The lack of a structured approach to spares budgeting combined with new DoD requirements for readiness-based sparing generated a need for an automated means to satisfy the AIR-412 budget requirements.

Background

Figure 1. SPARES BUDGETING INFORMATION CHALLENGE



Definition of Key Terms in Spares Budgeting

Spares	Spares are extra equipment assemblies, subassemblies, and piece parts which are purchased and stocked to repair or replace equipment that fails during the operation of the aircraft.
WRAs, SRAs, & Piece Parts	In the Department of the Navy, equipment assemblies or components are referred to as Weapon Replaceable Assemblies (WRAs). WRAs can have from 0 to 5 indentures. The first indenture consists of Shop Replaceable Assemblies (SRAs), which are subassemblies of the WRA; the next indenture consists of subassemblies of the SRAs; and this can continue until the last indenture which consists of piece parts.
Initial Budget	An initial spares budget is the budget for spares while the new aircraft or system is in its development phase. (However, due to budgetary lead times, the preparation of the budget must start when the new aircraft or system is first approved which is prior to the development phase.)
MSD	In the normal life cycle of a new aircraft or system, the development phase follows the initial definition and design phase and precedes the production and deployment phase which is marked by the Material Support Date (MSD).
	Once a new aircraft or system reaches its MSD, initial sparing stops as the normal DoD logistics system assumes responsibility for providing logistics support..
Interim Support	Initial spares are divided between spares for components that are already in the DoD logistics system and those that are new. Components that are already in the system are called "common" components and are budgeted by the Navy's Aviation Supply Office (ASO). New components are referred to as components under interim support and are budgeted by AIR-412.

Definition of Key Terms in Spares Budgeting

Initial Interim Spares Budget

An initial interim spares budget is therefore the dollars which the Navy allocates for aircraft developers to purchase spares for new components for new aircraft/systems during their development prior to MSD.

Readiness-Based Sparing

The center of any sparing methodology is its goal. Historically, DoD sparing has been demand-based, that is, spares are procured and stocked to satisfy demand resulting from component failures.

Readiness-based sparing is an alternative to demand-based sparing. Under readiness-based sparing, spares are procured and stocked to achieve an operational availability (Ao) threshold. The objective is still to satisfy demand, but in addition, to provide greater levels of satisfaction for components having greater impact on aircraft Ao.

SBM

The SBM was developed as a computer tool to assist AIR-412 LEMs in calculating readiness-based initial interim spares budgets.

The model can produce a spares budget for:

- a totally new model aircraft,
- a new series of an existing aircraft, or
- a new system being installed on one or more existing aircraft.

SBM contains 2 modules. The first is a construct module which builds a component database for the budget item based on similar/same associations.

The second module is a budget model which computes a spares budget based on component data, program data, and budget parameters.

Both of these modules and supporting software are referred to as the SBM.

Model Description

SBM System

Figure 2 shows the computer system and information flow that comprises the SBM. The major elements of the system are:

- the data collection,
- the information entry,
- budget generation and analysis, and
- documentation.

The User's Manual addresses the middle 2 elements which are the PC-based elements which you would use to prepare a budget.

Data Collection

The data collection element of the SBM system consists of the mainframe computer programs that construct the SBM Master File. These programs extract data from the major Naval aviation logistics systems and summarize that data into the SBM Master File.

Documentation

SBM documentation consists of a Systems Manual, this User's Manual, and the Operations Manual.

You should only be familiar with the User's Manual unless you are involved in the programming of the model.

AIR-412 SPARES BUDGETING MODEL

Model Description

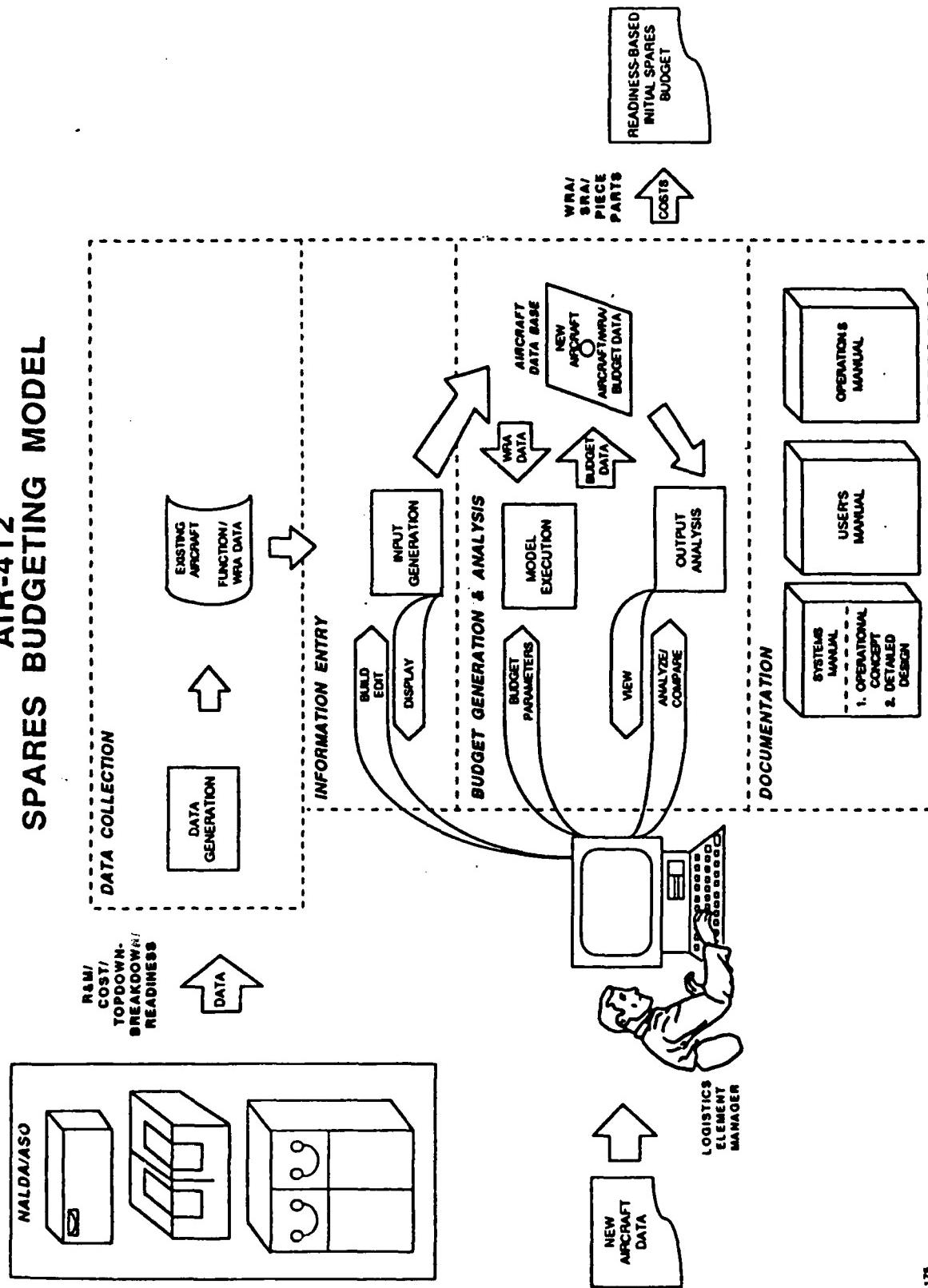


Figure 2

SBM Advantages

Use of the model has the following advantages:

- its budgets are targeted on readiness;
- it represents a structured, auditable approach to budget preparation which can be repeated and updated as required;
- its budgets are more objective and defensible than budgets based on subjective judgments;
- its budgets can be based on the most current data available and, as such, would be the best possible estimates; and
- revisions to your budget and "what-if" testing can be performed easily and quickly.

Security

You can operate the model in an unclassified environment. However, as mentioned in Section 3 of Volume IV, the preparation of the SBM Program Data Worksheet does involve classified information.

Classified Data

Specifically, "information reflecting baseloading of battle group or shore establishment inventory resources, their composition or condition" is classified. Therefore, the specification of number of aircraft by named site is classified.

Data Worksheet

To exclude this specification from model processing, you must use the SBM Program Data Worksheet (See Section 3 of Volume IV for copy of actual form).

With the worksheet, you transform named sites into numbered scenarios and number of aircraft at a site into total flying hours.

IMPORTANT: ONCE YOU ENTER CLASSIFIED DATA ON A WORKSHEET, IT IS CLASSIFIED AND MUST BE TREATED ACCORDINGLY.

Model Operation

The model works with the unclassified scenario numbers and their associated total flying hours. Therefore, the normal operation of the model should not present a security risk.

SECTION 3

INSTRUCTIONS FOR USING THE MODEL

The SBM computes a new aircraft or new aircraft system budget for initial interim soars located at the retail site level(s) and at the wholesale depot level.

General instructions on how to work on screens are not contained in this section, but can be found in Section 4.

In this section:

- **Applications** defines the 3 SBM applications, i.e., readiness-based soaring for a new aircraft, a new series of an existing aircraft, or a new aircraft system.
- **The SBM Budget** discusses the nature of the budget which is produced by the model.
- **SBM's 3 Step Approach** outlines the steps you must follow in using the model to prepare a budget.
- **Activities Involved in Building the Model Input** addresses Step 1.
- **Activities Involved in Running the Model** reviews Step 2.
- **Activities Involved in Analyzing the Model Output** discusses Step 3.
- **Activity Timetable** proposes a timetable for conducting each step.
- **SBM Limitations and Assumptions** discusses what the model can not do and what assumptions are part of the model and its output.

Applications

New Aircraft

You can use the SBM to calculate an initial spares budget for a totally new aircraft (e.g., the V-22).

This application is the most involved since a large portion of the WRAs in a totally new aircraft may come under interim support. Moreover, even for those WRAs that are common to other existing aircraft and would not be under interim support, you must identify the WRAs and aircraft relationships.

New Series

You can use the SBM to calculate an initial spares budget for a new series of an existing aircraft (e.g., the A-6F).

This application is less involved than the totally new aircraft application because a database exists for the old model which the new model is upgrading. Therefore, a large portion of the WRAs may remain the same and not come under interim support.

However, for new WRAs, you will still have to identify WRAs on other existing aircraft which match them.

New System

The third application is a new aircraft system.

Aircraft system refers to a collection of components designed and developed to perform a specific function. This use of system should not be confused with the 2-digit Work Unit Code (WUC) systems defined in Section 5 of Volume IV. An aircraft system may be contained in one or more WUC systems.

Typically, a new aircraft system is an upgrade to existing equipment and is to be installed on a number of aircraft models. It may only involve a few WRAs but it may span several aircraft models.

Applications

If you are budgeting a new system that is being installed on several aircraft:

- you may prepare a budget for the new system as if it were a stand alone item independent of the aircraft;
- you may elect to prepare a budget for the system on one representative aircraft and use it to estimate a budget that would cover all aircraft; or
- you may choose to prepare a budget for each aircraft and sum these budgets into one budget.

If you elect to budget a new system as a stand alone item, you can not budget towards the readiness of the aircraft that the system is going on. You can only budget towards the readiness of the system itself.

The SBM Budget

Configuration Based

The budget which the SBM generates is based on the configuration of the aircraft or system being spared. The term "configuration" refers to the components of the new aircraft or aircraft system and how those components are defined in terms of aviation systems, subsystems, and WRAs.

As previously noted, not all components in a new aircraft or new aircraft system are reflected in an SBM budget because some of the components will be identified as "common", i.e., already in the DoD logistics system.

(Even though these components are not included in the budget, they are entered into the model so that their downtime can be included in the computation of the aircraft's Ao.)

Limited Data

Since initial spares budgets are produced early in the life cycle of a new aircraft or system, configuration data is limited.

Moreover, leadtimes for obtaining spares dictate that budgets be prepared for years that are two years before the actual deployment or installation of the new aircraft or equipment. To overcome data deficiencies caused by this situation, the model relies on similar or same components on existing aircraft to generate data for new components.

Accuracy

Like the output from any model, the SBM budget is an estimate whose accuracy depends on the accuracy of the data going into the model as well as the accuracy of the model structure. In this case, the process being modeled is fairly well known and the accuracy of the model structure is not a major issue.

However, data accuracy is an issue since little may be known of the configuration and reliability of the new aircraft or system.

The SBM Budget

For this reason, the SBM was designed to accept new configuration and reliability data as it becomes available. Accordingly, SBM budget estimates should improve as the new aircraft or system is developed.

Budget Estimate

The objective of the SBM is to provide a budget number and is not to produce an execution number. That is, the SBM produces a dollar estimate of the costs of spares required to maintain a performance goal for a new aircraft or equipment during its initial deployment or installation.

It does this by estimating the number of spares needed at the retail and wholesale sites. However, the actual number of spares required during budget execution will vary depending on the accuracy of the new component data that went into computing the budget estimate.

The correlation between the budget number and the execution number will improve as better data becomes available to the model as the new aircraft/system is being developed and information fed to the appropriate LEM.

SBM's 3 Step Approach

As illustrated in Figure 4, you formulate an SBM spares budget by:

- constructing or building the model input, i.e., you take the information you have on the new aircraft and associate it with information on existing aircraft;
- running the model, i.e., you execute the model with the aircraft data and budget parameters to develop the cost trade-off between aircraft Ao and increasing levels of spares; and
- analyzing the model output, i.e., you select the spares level for budget submittal that meets either an Ao goal, a budget dollar goal, or a return-on-investment goal.

COMPUTING A BUDGET WITH THE MODEL

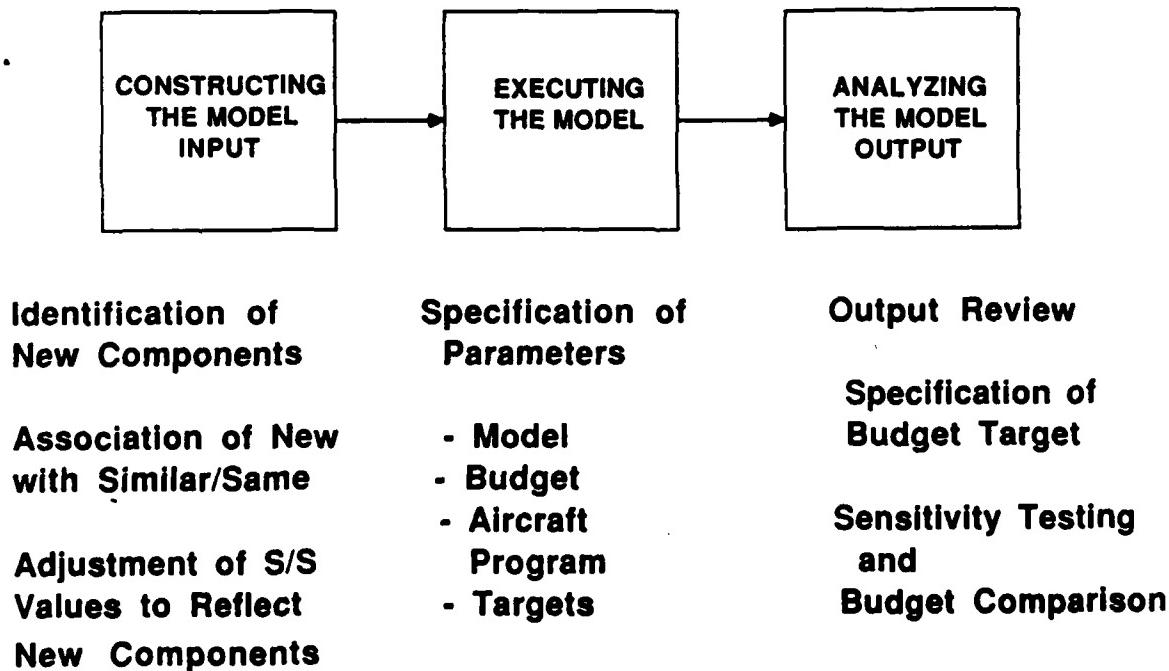


Figure 4. Steps in Computing a Budget with the Model

Activities Involved in Building the Model Input

Section 4 of Volume II details the process of building an SBM database for each SBM applications. In general, the construction of the model inout involves 5 activities.

Research

You conduct research to identify the WRAs in the new aircraft or new equipment. To aid your research, the new aircraft or equipment acquisition process has some documents that might help. See Section 1 of Volume IV for more details.

Similar/Same Associations

Using the model, you , and others as required, associate the new systems/subsystems/WRAs with similar/same systems/subsystems/WRAs on existing aircraft.

Data Modification

You modify the WRA records generated from the similar/same association to include any information you may have on the new WRAs. (Refer to Volume IV for more on this).

Review

You, and others as required, review the model inout through screen and printed reports.

Adjustments

Based on that review, you set global adjustments to reflect available information on the new systems/subsystems/WRAs.

Activities Involved in Running the Model

Section 5 of Volume II explains in detail the process of running the model. Overall, it involves 3 activities.

Research

You conduct research to quantify elements in the model parameter file. They include:

- model parameters (e.g., number of budget years),
- budget parameters (e.g., cost factor applied against WRA unit price each year), and
- aircraft program data (e.g., flying hours in a site scenario).

Parameter Setting

Using SBM software, you set the values of all parameters in the parameter file, which you could print and review for accuracy.

Model Execution in Analytical Mode

With the validated parameter file, you execute the model in the analytical mode.

Activities Involved in Analyzing the Model Output

Section 6 of Volume II lists the detailed procedures for analyzing the model's output. They are summarized in the following 7 activities.

- | | |
|--|--|
| Output Review | You review the cost vs readiness output from the analytical mode to determine what the budget span is for a range of operational availabilities. |
| Re-execution in Analytical Mode | If you want to see a different cost vs readiness table, you reset the spending rate thresholds in the parameter file and rerun the model in the analytical mode. |
| Target Selection | You select a budget target in terms of either a spending rate, a budget dollar, or an operational availability goal. |
| Model Execution in Target Mode | You include the budget target in your parameter file and run the model in the target mode. |
| Output Review | You review the output from the target mode through screen and printed reports.

Note: The output from running the model in the target mode is the SBM budget for your new aircraft or new equipment. |
| Re-execution in Target Mode | As required, you reset the budget target or set constraints on individual WRAs and rerun the model in the target mode. |
| Sensitivity Analysis | If necessary, you evaluate the sensitivity of the budget to changes in RM&S or cost data by changing the values of sensitivity factors in the parameter file and rerunning the model. |

Activity Timetable

Short Budget Window LEMs must usually prepare budgets in a short time period (from 1 day to 2 weeks) and budget revisions in the same short time periods.

**Input Prior To
Window**

To allow time for model execution and output analysis, LEMs should build their model input prior to the actual budget period. By performing this activity during "less hectic" periods, the activities required during the "budget drill" periods will be minimized.

Execution Time

Actual model execution time is short, usually between 5 and 10 minutes on an IBM AT-compatible PC. Combines this with the 5 to 10 minute process of preparing a parameter file means that the LEM should be able to produce an initial budget within one hour after building the model input.

SBM Limitations and Assumptions

The following limitations and assumptions govern the use of the model to prepare a budget:

1 Series at a Time The model produces a spares budget for one type model series of an aircraft at a time. If you want to produce a budget for different series of aircraft, you must make separate runs of the model for each series.

10 Year Max The model can produce a budget for one to ten years.

Independence Between Budget Years The model assumes that the budget for one year is independent of the budget for another year.

(In actuality, spares previously purchased for a site do, to a limited extent, reduce the number of spares needed to satisfy an additional requirement at that site. However, the potential overage created by the assumption of independence is somewhat offset by the model's omission of attrition.)

In cases where you can quantify the overage as being significant, you can enter the overage in the model and the model will accept it as a direct reduction to the number of spares it computes for a year.)

Maximum of 10 Site Scenarios Similar retail sites (i.e., sites having the same number of flying hours and same ship/shore designation) are grouped together under a site scenario. The maximum number of site scenarios is ten.

1 Wholesale Site The model assumes one wholesale depot site.

(If you do not want to consider stockage at a depot level, you must set the depot stockage goal to zero and the depot resupply time to

SBM Limitations and Assumptions

the depot repair time or procurement leadtime, whichever applies.)

\$'s Based on # of Aircraft or Installations

The model computes budgets on the basis of

- numbers of aircraft deployed in the case of new aircraft or
- numbers of installations in the case of new systems.

The model does not directly deal with the case of sparing for increased flying hour program at a site from one year to another.

(If you do want to spare for an increased flying hour program, you can either (a) adopt the higher program starting the first year or (b) enter the total program each year and remember to subtract the budgets for the previous years, starting with year 1.)

Lowest Level = WRA

The SBM is a WRA model and, as such, does not directly deal with SRAs and piece parts. Rather it estimates SRA costs as a percent of NRA costs and piece part costs as a percent of the sum of NRA and SRA costs.

Relationships between WRAs

The SBM assumes that the sparing of one WRA is independent from the sparing of other WRAs. However, through impact factors, the model does take into account the correlation between failures of different components. And, in setting spares levels for a readiness goal, the model makes the most cost effective decision across all spares.

WUC Structure

The model employs the WUC structure of an aircraft to identify its systems, subsystems, and WRAs.

If codes are not available, you can assign "temporary" codes to represent WRAs and/or subsystems.)